Section 2-7: Properties of Exponents and Section 2-8: Zero and Negative Exponents

By the end of this lesson, you should be able to answer:

- How do you choose appropriate units of measure?
- How do you evaluate variable expressions?
- How do you write numbers using zero and negative integers as exponents?
- How do you write numbers in scientific notation?

Where you might see this in the real world:

- Biology, finance, computers, population, physics, astronomy

Define the following terms:

1. Exponential form

2. Base

3. Exponent

4. Standard Form

5. Scientific Notation

An organism divides into two new organisms each hour. Fill in the table for the number of organisms after each hour.

Hours	1	2	3	4	5
# of organisms	2				

What pattern do you notice?

How many will there be in the each of the following hour?

a. Sixth hour: b. Seventh hour: c. Tenth hour:

In what hour will there be 2000 organisms?

What idea did you use to figure out this problem? Is there a general equation you can use?

The first way that we have seen exponents is in a term like x^3, which means that we have $x \bullet x \bullet x$. We can evaluate these problems like any other variable expression. The symbol ^ is used on a TI-84 and some scientific calculators. On others, the symbol y^x is used.

Example 1: Evaluate for $x = .8$ and $y = 1.2$.

a. $3x^2y$ b. $(4x)^3y^2$

***Notice that in these problems, only the variable or number that immediately precedes the exponent is taken to that power.

Now let's take a look at some of the different properties that come up:

Product Rule:

Power Rule:

Power of a Product Rule:

Quotient Rule:

Power of a Quotient Rule:

Example 2: Simplify.

a. $3^2 \bullet 3^5$ b. $(6m^4)^2$

Example 3: Evaluate for $x = 1/2$ and $y = 2/3$.

a. x^2y b. $3x^3y^2$

Here are two more properties we will see when dealing with exponents:

Zero Property of Exponents:

Property of Negative Exponents:

Example 4: Simplify each expression. Write the answer with a positive exponent.

a. $\frac{x^2}{x^8}$ b. $y^3 \bullet \frac{1}{y^4}$ c. $(z^{-3})^2$

As you can see in Example 4, we can do any combination of properties of exponents in any order. The main idea is to remember to complete as many steps as possible. If you can still apply one of the properties, you are not done simplifying.

Example 5: Evaluate each expression when $m = -2$ and $n = 4$.

a. $6m^4$ b. $(n^3)^{-2}$ c. m^5n^{-3}

Exponents come in handy when we are trying to write really large numbers, or numbers that are so close to zero that they have numerous decimal places. We use scientific notation to do this. As stated in your definition, when using scientific notation, it is imperative that the factor is greater than or equal to 1 and less than 10. The second factor will be a power of ten, which really only tells us how many decimal places to move our decimal.

Example 6: Write in scientific notation.

a. .0000013

b. 230,000,000,000

Example 7: Write in standard form.

a. $7.2 \cdot 10^{6}$

b. 3.5×10^{-9}

This idea is very useful in the sciences, as many times you will run into really large or really small numbers. It is quite difficult to work with a number that is several digits long, so we use scientific notation.

Example 8: The mass of one hydrogen atom is $1.67 \cdot 10^{-24}$ gram. Find the mass of 2,700,000,000,000,000 hydrogen atoms.

Problem Set:

"When you're screwing up and nobody's saying anything to you anymore, that means they gave up [on you]…When you see yourself doing something badly and nobody's bothering to tell you anymore, that's a very bad place to be. Your critics are the ones who are telling you they still love and care." – Randy Pausch